ASED http://e-ASED.org
Animal Systematics, Evolution and Diversity

Anim. Syst. Evol. Divers. Vol. 34, No. 2: 92-95, April 2018
https://doi.org/10.5635/ASED.2018.34.2.016

Additional Report of the Genus *Asthena* (Lepidoptera: Geometridae) from Korea

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ABSTRACT

After the revision of the Korean species of *Asthena* Hübner, we additionally added one new species, *Asthena koreana* sp. nov. and two new records, *Asthena hamadryas* Inoue and *Asthena sachalinensis* (Matsumura) from Korea. *Asthena koreana* sp. nov. can be characterized by the white forewing with a costally bifurcated, loop-shaped antemedial line, black minute discoidal dot and single postmedial line and white hindwing with straight antemedial line and black discoidal dot. *Asthena hamadryas* Inoue can be distinguished by a white forewing with a costally loop-shaped antemedial line and undulating, double lines of the postmedial line, as well as a white hindwing with four light ochreous waved lines without discoidal dots. *Asthena sachalinensis* can be distinguished by their whitish forewing with thick light brownish postmedial lines and minute black discoidal dot on the costal loop of the antemedial line and whitish hindwing with light brownish medial lines with minute black discoidal dot. Currently, eight species of the genus are known in Korea. We provided a revised key to the Korean species of the genus.

Keywords: new record, Lepidoptera, Geometridae, Korea

INTRODUCTION

The genus *Asthena* Hübner, which was described based on the type species *Geometra candidata* (Denis and Schiffermüller, 1775) (a junior synonym of *Asthena albulata* Hufnagel, 1767), comprises about 22 species in the Palearctic region and India (Scoble, 1999; Xue and Scoble, 2002). The diagnostic characteristics of the genus include the narrow and non-projected frons, unstalked R_1 of the forewing, sacculus with two projections and spinular cornuti in the vesica (Xue and Scoble, 2002). In South Korea, six species of the genus were listed (Choi, 2012): *Asthena amurensis* (Staudinger, 1897), *A. nymphaeata* (Staudinger, 1897), *A. anseraria corculina* Butler, 1878, *A. ochrifasciaria* Leech, 1897, *A. octomacularia* Leech, 1897 and *A. undulata* (Wileman, 1915).

Sato (2009) examined the species *Asthena hamadryas* Inoue, 1976 that was synonymized with *A. amurensis* (Xue and Scoble, 2002) and found that *A. hamadryas* is a valid species based on the genitalia characteristics. We found that the specimens of *A. octomacularia* in Choi (2012) were incorrectly identified and that they actually belonged to *A. sachalinensis* (Matsumura, 1925). We also found four specimens that were externally similar to *A. anseraria corculina*, but could be separated by the shape of the postmedial line of the hindwing and the male and female genitalia. In sum, eight species of the genus are known in Korea, including one new species.

MATERIALS AND METHODS

Moths were collected using a UV-light bucket trap (BioQuip, USA) during night or attracted to the UV-light and resting on a white screen hanging between poles. All collected adults were preserved in a freezer and mounted for examination. For slide preparation of male and female genitalia, each specimen was prepared by boiling the abdomen in 10% KOH for approximately 20 min. Scales and tissues were removed, stained with Chlorazol Black, and mounted on slides in Euparal solution. For wingspan measurements, the distance from the tip of the left forewing to the tip of

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eISSN 2234-8190

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the right forewing was used. All specimens examined have been deposited in the Department of Environmental Education, Mokpo National University (MPNU). Examination of adults, including the male and female genitalia, is in reference to Xue and Scoble (2002). Abbreviations are as follows: GB, Gyeongsangbuk-do; GG, Gyeonggi-do; GN, Gyeongsangnam-do; GW, Gangwon-do; JN, Jeollanam-do; and TL, type locality.

SYSTEMATIC ACCOUNTS

Order Lepidoptera Linnaeus, 1758
Family Geometridae Stephens, 1829
Subfamily Larentiinae Duponchel, 1845

Genus *Asthena* Hübner, [1823] 1816

Type species. *Geometra candidata* ([Denis and Schiffermüller, 1775]).

=*Roessleria* Breyer, 1868: xix. Type species: *Geometra candidate* ([Denis and Schiffermüller, 1775]).

Key to species of the genus *Asthena* in Korea

1. Both fore and hindwings with a black minute discoidal dot ··· 2
− Both fore and hindwings without a black minute discoidal dot ··· 7
2. Both wings with many waved medial lines ··· 3
− Both wings without many waved medial lines; postmedial line of forewing with a pair of black dots ··· *A. undulata* (Fig. 1G)
3. Central fascia of forewing distinct with brownish band ··· *A. ochrifasciaria* (Fig. 1F)
− Central fascia of forewing distinct with waved lines ··· 4
4. Postmedial line of forewing consists of double lines ··· 5
− Postmedial line of forewing consists of a single line ··· 6
5. Outer line of postmedial line of forewing thick, tinged with gray ··· *A. sachalinensis* (Fig. 1E)
− Outer line of postmedial line of forewing thin ··· *A. amurensis*
6. Antemedial line of forewing costally bifurcated and discoidal dot on inner antemedial line; antemedial line of hindwing straight ··· *A. koreana* (Fig. 1C)
− Antemedial line of forewing costally without bifurcated and discoidal dot next to inner antemedial line; antemedial line of hindwing waved ··· *A. anseraria corculina* (Fig. 1D)
7. Subterminal line of forewing costally and medially distinct with thick and continuous line ··· *A. nymphaeta* (Fig. 1B)
− Subterminal line of forewing costally and medially with broken line ··· *A. hamadryas* (Fig. 1A)

[1*]*Asthena hamadryas* Inoue, 1976 (Fig. 1A)

Asthena hamadryas Inoue 1976: 16. TL: Japan: Shionomata, Tokamachi, Niigata Pref.

Asthena amurensis: Xue and Scoble, 2002: 83 (part); Choi, 2012: 152 (part).

Material examined. Korea: 1♂, 2♀♀, GW: Hwacheon-gun, Mt. Gwangdeoksan, 38°06′N, 127°26′E, 22 Jun 2006, Choi SW; 1♂, 1♀, GG: Gapyeong-gun, Mt. Hwayasan, 37°40′N, 127°25′E, 16 Jun 2004, Choi SW; 1♀, GB: Yecheon-gun, 36°40′52.6″N, 128°35′36.4″E, 25 Jun 2008, Kim SS; 1♂,

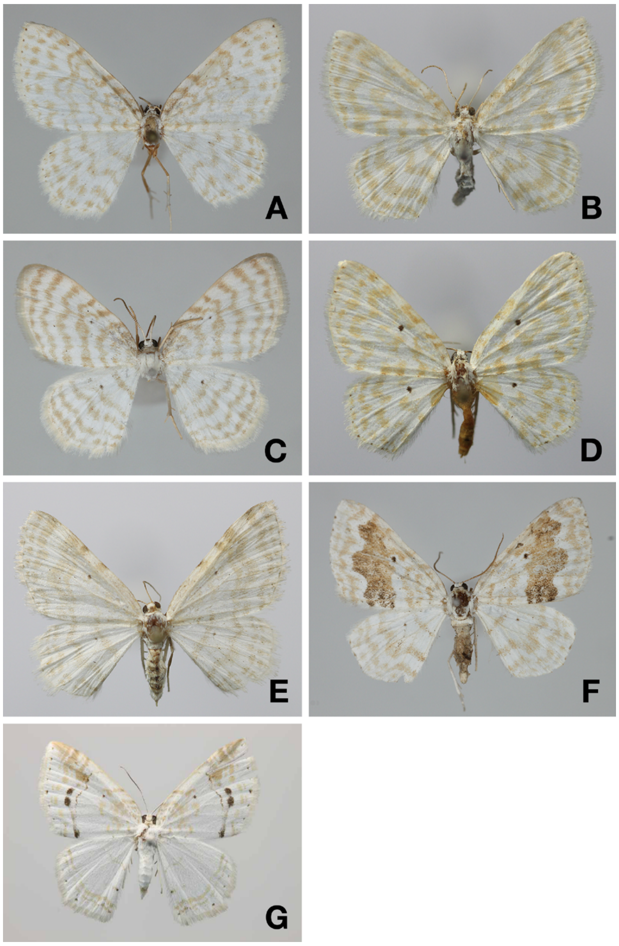

Fig. 1. Adults of the genus *Asthena* Hübner in Korea. A, *Asthena hamadryas* Inoue; B, *Asthena nymphaeata* (Staudinger); C, *A. koreana* Choi and Kim, sp. nov.; D, *Asthena anseraria corculina* (Butler); E, *Asthena sachalinensis* (Matsumura); F, *Asthena ochrifasciaria* Leech; G, *Asthena undulata* (Wileman).

Korean name: [1*]점줄흰물결자나방(신칭)

4♀♀, GN: Hadong-gun, Mt. Jirisan, 35°18′21″N, 127°38′11″E, alt. 702 m, 26 Aug 2008, 3 Jun 2011, 11 May 2012, Choi SW; 1♂, 1♀, Hamyang-gun, Mt. Jirisan, 35°21′18″N, 127°38′08″E, alt. 760 m, 26 Aug 2008, 14 Aug 2013, Choi SW; 6♂♂, 8♀♀, JN: Gurye-gun, Mt. Jirisan, 35°17′N, 127°29′E, alt. 650 m, 27 May 2006, 22 May 2008, Choi SW.

Diagnosis. Wingspan 19–22 mm. Distinguished by white forewing with light ochreous waved lines from base to termen, antemedial line costally loop-shaped, postmedial lines undulating, double lines, discoidal dot absent; white hindwing with four light ochreous waved lines, discoidal dot absent; male genitalia with short uncus, long sclerotized subscaphium, middorsally long tapered labidies, and large three pointed sacculus process on hairy valve; female genitalia with broad antrum, straight ductus bursae with a colliculum and large spinular stellate signa patch on corpus bursae.

Distribution. Korea, Japan.

Remarks. Choi (2012) recorded *Asthena amurensis* (Staudinger) based on the specimens of this species, following Xue and Scoble (2002). *Asthena amurensis* (=*Cidaria candidata amurensis* Staudinger) was first recorded by Leech (1898) from Wonsan, North Korea and then by Herz (1904) from Kimhwa, North Korea. Since them, no additional record of the occurrence is reported. Here, we newly report the occurrence of *A. hamadryas* in Korea for the first time. This species is bivoltine in Korea, flying from May to June and August.

[1]**Asthena koreana* Kim and Choi sp. nov. (Figs. 1C, 2A–C)

Type: Holotype: ♂, GW: Youngweol-gun, Ssangyong, 18 May 2006, Sohn JC leg. Paratypes: 1♂, GW: Taebaeck-si, Dogye, 17 May 2014, Kim SS; 1♀, GW: Youngweol-gun, Ssangyong, 31 May 2013; 1♀, GW: Youngweol-gun, Mt. Hambacksan, 6 Aug 2012, Kim SS.

LSID: B79363CC-D577-4F5D-9A5D-4513386744FB.

Diagnosis. Distinguished by white forewing with light ochreous waved lines from base to termen, antemedial line costally bifurcated like loop-shaped and black minute discoidal dot, postmedian undulating single line; white hindwing with five light ochreous waved lines, straight antemedial line and black minute discoidal dot; male genitalia with short uncus, long sclerotized subscaphium, middorsally long tapered labidies, tongue-shaped juxta, large fork-shaped sacculus process on hairy valva and linear patch of spinular cornuti; female genitalia with broad funnel-shaped antrum, straight, sclerotized ductus bursae with colliculum and long spinular signa patch on corpus bursae.

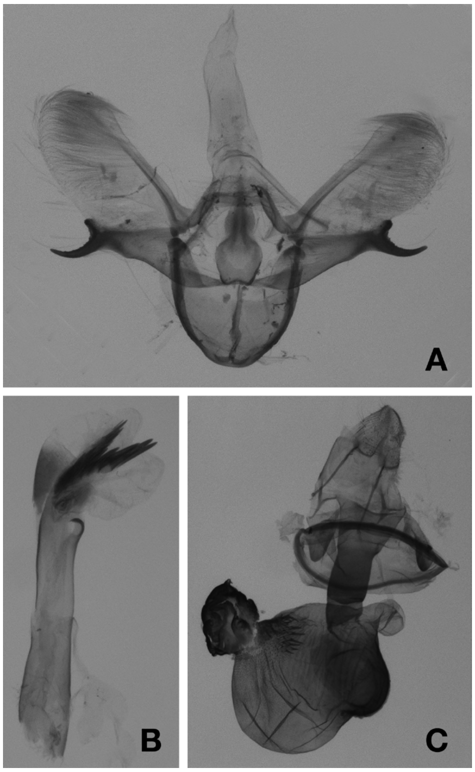

Fig. 2. Male and female genitalia of *Asthena koreana* Choi and Kim, sp. nov. A, Male genital capsule; B, Aedeagus; C, Female genitalia.

Description. Wingspan 19–21 mm. Antennae filiform; frons broad, top covered with light ochreous scales, bottom with white scales; labial palpi covered with whitish scales, short in length, almost equal to eye diameter, barely projected beyond frons. Body and legs covered with white hairs. Forewing: ground color white; basal line light ochreous, dentate; antemedial lines, light ochreous, weakly waved, costally loop-shaped; black minute doscoidal dot present on inner costal part of antemedial line; postmedian single line, light ochreous, waved; double areoles; subtermen and termen with light ochreous waved lines; underside basal and medial lines tinged with brownish scales except dorsum. Hindwing: ground color white; antemedial line light ochreous, straight; postmedial and subterminal lines light ochreous, waved; black minute discoidal dot present. **Male genitalia.** Uncus short, tapered; tegumen bell-shaped, almost half the length of the vinculum and saccus; subscaphium long, weakly sclerotized; transtilla thin, slender labidies from both middorsal parts; juxta long, tongue-shaped; saccus large, medially

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Korean name: [1]*한국흰물결자나방(신칭)

projected. Valva long, distally expanded, hairy; costa long, slender, sclerotized; sacculus slender, triangular, long, fork-shaped process at distal end. Aedeagus long, rod-shaped; vesica with linear patch of large spinular cornuti. **Female genitalia.** Papillae anales weakly projected, membranous; apophyses posteriores long, almost three times that of apophyses anteriores; antrum broad, funnel-shaped, sclerotized; ductus bursae straight, sclerotized, colliculum present; corpus bursae ovate, membranous; rounded signa patch that consists of long spinular processes.

Distribution. Korea.

Remarks. This new species is externally very similar to *Asthena anseraria corculina* Butler, but can be distinguished by the shape of the antemedial line of forewing, which is straight, rather than waved in *A. anseraria corculina*. For correct identification, the examination of the male and female genitalia is necessary. The male genitalia of *A. koreana* sp. nov. are distinguished from those of *A. anseraria corculina* by the large tongue-shaped juxta, the fork-shaped sacculus process on the valva and the V-shaped patch of spinular cornuti. The female genitalia of *A. koreana* sp. nov. are distinguished from those of *A. anseraria corculina* by the rounded patch of the spinular signa of corpus bursae. This species is bivoltine, flying from May to June and August.

[1]**Asthena sachalinensis*** **(Matsumura, 1925) (Fig. 1E)**

Acidalia sachalinensis Matsumura, 1925: 158. TL: Russia: South-Sachalin (Ichinosawa, Tonnai).

Material examined. 1♂, GW: Youngweol-gun, Mt. Hambacksan, 6 Aug 2012, Kim SS; 1♀, Pyeongchang-gun, Mt. Jungwangsan, 14 Jun 2013, Kim SS; 10♂♂, 7♀♀, JN: Gurye-gun, Mt. Jirisan, 35°18′13″N, 127°33′35″E, alt. 1,320 m, 19 Jul 2005, 20 Jun 2007, 26 Jun 2008, 22 Jun 2009, 23 Jul 2009, 10 Aug 2012, 14 Aug 2013, 21 Jun 2014, Choi SW.

Diagnosis. Wingspan 16–21 mm. Distinguished by whitish forewing with light brownish double parallel postmedial lines and minute black discoidal dot on costal loop of antemedial line; whitish hindwing with light brownish medial lines with minute black discoidal dot; male genitalia with pair of thumb-shaped labidies on transtilla, long and slender juxta with one pair of long sharp basal processes and strongly hooked sacculus process on valve; female genitalia with funnel-shaped antrum and heart-shaped signa patch of corpus bursae.

Distribution. Korea, Japan, China.

Remarks. Choi (2012) misidentified *Asthena octomacularia* Leech sensu Choi, 2012 based on the specimens of this species. The occurrence of *A. octomacularia* in Korea has been uncertain up to now. This species is bivoltine, flying from June to July and August.

ACKNOWLEDGMENTS

We thank two anonymous reviewers for their critical comments on the manuscript and students of Department of Environmental Education, Mokpo National University for their help to collect moths. This study was supported by a grant from the National Institute of Biological Resources (NIBR), funded by the Ministry of Environment (MOE) of the Republic of Korea (NIBR 201701203).

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Received April 10, 2018
Revised April 17, 2018
Accepted April 18, 2018

Korean name: [1]*두줄무늬흰물결자나방 (신칭)